The Application of High-resolution LIDAR Elevation Models for Understanding Landscape Evolution: an Example from the North Mountain, Nova Scotia

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A high-resolution laser altimetry (LIDAR) digital elevation model (DEM) is applied to geological problems related to bedrock and surficial mapping and the relationship to earth-surface processes, including fluvial incision and surface runoff, in a region of the North Mountain in Nova Scotia. The LIDAR data are validated using GPS and traditional survey methods under the forest canopy. The LIDAR DEM has been used to map three flow units with contrasting physical and chemical characteristics, and previously unidentified craters within the Jurassic North Mountain Basalt Formation. Field investigations confirm the contacts identified from the DEM. Petrographic analysis of samples collected on transects across the craters indicates the crater rims are composed of quenched lava. The craters are interpreted to be a result of the interaction between partially solidified lava and surface or shallow groundwater. Morphometry has been calculated from the DEM for basins draining into the Bay of Fundy from the adjacent North Mountain that were formed by fluvial incision, modified by glaciation and subsequently by fluvial processes. Stream longitudinal profiles have been extracted and used with drainage divides to determine stream incision depths, which are then related to the different flow units of the NMB. The variable resistance of the flow units to erosion by abrasion and plucking was tested in the laboratory using a shatterbox and the fracture density was estimated from drill core. The variable resistance to erosion of the three flow units controls the amount of incision that occurs within the streambed. Hydrographs and water chemistry parameters measured in two basins with different glacial till cover thickness indicate that the thick till promotes surface run-off and retards infiltration, thus increasing the stream's ability to incise. Several wave-cut terraces have been measured along the coastline in the thick till blanket areas. This paper demonstrates through a range of examples that the precision and enhanced resolution of LIDAR can improve our understanding of how landscapes form and evolve.

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